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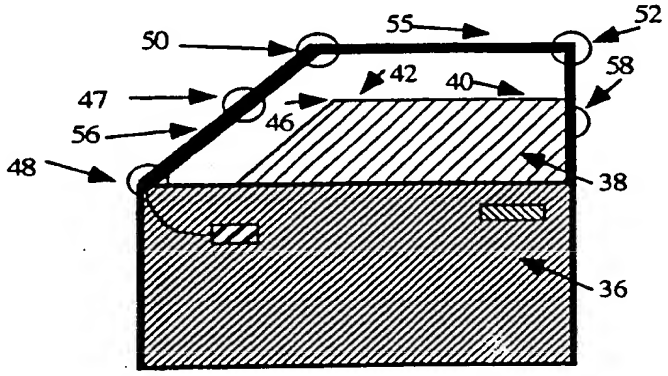
(54) Title: IMPROVED OBSTRUCTION DETECTION SYSTEM FOR A VEHICLE WINDOW



(57) Abstract

An obstruction detection system (10) for a vehicle window (30) includes a shade and/or a filter, and/or a dual chann monitoring system to prevent interference with the monitoring beam (18) by ambient noise; a transducer (48, 50 and 52) at eith end and one at an intermediate apex monitors obstructions relative to nonlinear, rectilinear or curvilinear edges (40); a wi angle transducer, closely aligned pair of transducers, or a mechanical interrupter is used to ensure tripping the beam (18) by ev small obstacles (86), and a camming surface (72) guides small obstacles into the path of the beam driven by the monitored wi dow edge.

IMPROVED OBSTRUCTION DETECTION SYSTEM FOR A VEHICLE WINDOW

FIELD OF INVENTION

This invention relates to an improved obstruction detection system, and more particularly to such a system which monitors nonlinear, curvilinear or rectilinear window edges; which shades and/or filters the receiver against noise that would mask the condition of the monitoring beam; eliminates blind spots in corners; guides small objects trapped by the advancing window to interfere with the monitoring beam; and uses a dual-channel technique to avoid disabling of the system by ambient noise.

BACKGROUND OF INVENTION

Automatic closure systems for vehicle windows are becoming more an more common wherein for example a driver can close any window in the vehicle by simple operation of an actuator button. Such automatic closure makes it essential that some safety interlock be provided to prevent obstructions such as human or animal parts; hands, arms, heads, paws, from being trapped between the edge of the closing window and the section of the frame that receives the window edge. Such safety precautions are even more imperative in more sophisticated systems which are wholly self-operating and do not even require actuation of an operating button or switch such as in systems which automatically close the windows of a parked car when rainfall is sensed.

Most vehicle windows including side windows, sun roofs and the like, do not have uniformly straight edges which engage with the frame. Typically those edges are rectilinear or curvilinear and a series of monitoring beams and pairs of transmitter and receiver transducers must be used to follow the edge contour.

Corner locations for transmitters and receivers present a special problem because they generally are accompanied by blind spots in which small obstructions like children's fingers can be missed so no alarm signal is delivered to stop advance of the closing windows.

A constant problem with obstruction detecting systems is that of ambient noise. Whether the monitoring beam be infrared, sound, ultrasound, light, or some other form of energy, ambient noise can trick the beam receiver into thinking the beam is uninterrupted and no obstacles have been detected because the noise supplies sufficient input to the receiver even when the beam is actually blocked.

SUMMARY OF INVENTION

It is therefore an object of this invention to provide an improved obstruction detection system for a vehicle window.

It is a further object of this invention to provide such an improved obstruction detection system for a vehicle window which eliminates interference with the monitoring energy by ambient noise.

It is a further object of this invention to provide such an improved obstruction detection system for a vehicle which efficiently monitors even nonlinear window edges.

It is a further object of this invention to provide such an improved obstruction detection system for a vehicle which avoids blind spots in corners where obstructions may not be detected.

It is a further object of this invention to provide such an improved obstruction detection system for a vehicle which can detect even very small obstructions in the corners.

It is a further object of this invention to provide such an improved obstruction detection system for a vehicle in which obstructions otherwise overlooked are guided to interrupt the monitoring beam.

The invention results from the realization that a truly simple, effective obstruction detection system for a vehicle window can be effected by using one or more of a shade, a filter or a dual-channel monitoring system to prevent interference with the monitoring beam by ambient noise, by using a transducer at either end and one at an intermediate apex to monitor nonlinear, rectilinear or curvilinear edges; by using a wide angle transducer, closely aligned transducers, or mechanical

interrupters to ensure tripping the beam by even small obstacles; and by using a camming surface to guide into the path of the beam small obstructions driven by the monitored window edge.

This invention features a dual-channel obstruction and detection system for monitoring the closure of the edge of a vehicle window with its frame. There is a first channel including a first transmitter and a spaced first receiver mounted with the frame proximate the section of the frame which receives the edge of the window for establishing a first energy beam propagating along the section of the frame. A second channel includes a second transmitter and a spaced second receiver mounted with the frame proximate the section of the frame which receives the edge of the window for establishing a second energy beam propagating along the section of the frame. The beams propagate in opposite directions, with the first transmitter and second receiver being at one end of the beams and the second transmitter and first receiver being at the other, for enabling each receiver to prevent an opposite field of view to the incident ambient noise energy.

In a preferred embodiment, the beam of the first channel and the beam of the second channel are different frequencies to prevent channel crossover of the beams. Alternatively there may be means for monitoring only one of the beams at a time in order to prevent channel crossover of the beams. There may be shade means extending from each receiver along the beam direction towards the associated transmitter for preventing ambient noise energy from striking the receiver and masking the condition of the associated beam. There may be filter means at each receiver for preventing ambient noise energy from striking the receiver and masking the condition of the associated beam, or both shading means and filter means may be used. The energy beam may be an infrared beam, a sound beam, an ultrasound beam, or a light beam.

The invention also features an obstruction detection system for monitoring the closure of a vehicle window with its frame, in which the window has a nonlinear edge to be monitored, the edge including two terminal portions and an intermediate portion.

There are three spaced transducers disposed on the section of the frame of the window which receives the edge. There is one transducer proximate each edge portion of the associated window for propagating a narrow energy beam between each of the terminal portions and the intermediate portion. The transducer at the intermediate portion is either a transmitter or a receiver, and the transducer at the terminal portions is of the other type, in order to closely conform the track of the beams to the nonlinear contour of the window edge. There are also means responsive to each receiver for indicating a blockage in the path of the window in response to an interruption of the beam.

In a preferred embodiment the edge may be rectilinear or curvilinear, the transducer and intermediate portion may be a transmitter, and the transducers at each terminal portion may be receivers. Or, the transducer at the intermediate portion may be a receiver and the transducer at each terminal portion may be a transmitter. If the receiver is at the intermediate portion, it may include a single sensor for receiving the beams from both transmitters. The sensor may be a wide angle sensor, and the sensor may be no larger than the smallest object to be detected obstructing the closure of the window. The receiver may include two sensors for receiving a beam from each transmitter, and the separation between the sensors may be smaller than the smallest object to be detected obstructing the closure of the window. The receiver may also include an interrupter normally biased clear of the sensors, but movable by an obstruction driven by closure of the window to overcome the bias and dispose the interrupter to block at least one of the beams. Alternatively, if the transducer associated with the intermediate portion of the edge is a transmitter, the transmitter may include two emitters, one for transmitting the beam through each receiver, and the transmitter may include an interrupter, normally biased clear of the emitters but movable by an obstruction driven by closure of the window to overcome the bias and dispose the interrupter to block at least one of the beams. The beams may be infrared, ultrasound, sound, or light. There may be a secondary transmitter and receiver

mounted with the frame for establishing a secondary beam remote from the section of the frame for monitoring progress of the edge of the window before closure of the window edge with the frame section.

The invention also features an obstruction detection system for monitoring the closure of the edge of a vehicle window with its frame. The transmitter mounted on the section of the frame which receives the window edge for transmitting and a receiver mounted on the section of the frame which receives the window edge and spaced from the transmitter for receiving a narrow energy beam adjacent that section of the frame. There are means responsive to the receiver for indicating a blockage in the path of the window in response to an interruption of the beam. Shade means extends from the receiver along the beam in a direction towards the transmitter for preventing ambient noise energy from striking the receiver and masking the condition of the beam.

In a preferred embodiment the system may also include filter means at the receiver for preventing ambient noise energy from striking the receiver and masking the condition of the beam.

The invention features an obstruction detection system for monitoring the closure of the edge of a vehicle window with its frame. There is a transmitter mounted on the frame which receives a window edge for transmitting and a receiver mounted on the section of the frame which receives a window edge and spaced from the transmitter for receiving a narrow energy beam adjacent the section of the frame. There are means responsive to the receiver for indicating a blockage in the path of the window in response to an interruption in the beam. Filter means at the receiver prevent ambient noise energy from striking the receiver and masking the condition of the beam.

In a preferred embodiment, there may also be shade means extending from the receiver along the beam direction toward the transmitter for preventing ambient noise energy from striking the receiver and masking the condition of the beam.

The invention also features an obstruction detection system for monitoring the closure of the edge of a vehicle window with

its frame. A transmitter mounted on the section of the frame which receives the window edge for transmitting and a receiver mounted on the section of the frame which receives the window edge and spaced from the transmitter for receiving a narrow energy beam adjacent the section of the frame. The receiver is mounted proximate a corner of the frame section. A cam surface receives an obstructing object driven by the closing window and guides it to block the beam. There are means responsive to the receiver for indicating a blockage in the path of the window in response to an interruption of the beam.

The invention also features an obstruction detection system for monitoring the closure of the edge of a vehicle window with its frame. There is a transmitter mounted on the section of the frame which receives the window edge for transmitting, and a receiver mounted on the section of the frame which receives the window edge and spaced from the transmitter for receiving an narrow energy beam adjacent that section of the frame. There are means responsive to the receiver for indicating a blockage in the path of the window in response to an interruption of the beam. A secondary transmitter and receiver mounted with the frame establishes a secondary beam remote from the section of the frame for monitoring progress of the edge of the window before closure of the window edge with the frame section. In all of the various embodiments a means may be included for diagnosing or determining whether the transmitter and receiver pairs are properly operating and if not to close the closing operation.

DISCLOSURE OF PREFERRED EMBODIMENT

Other objects, features and advantages will occur to those skilled in the art from the following description of a preferred embodiment and the accompanying drawings, in which:

Fig. 1 is a schematic block diagram of a circuit which generates and senses a beam that monitors and controls the window;

Fig. 2 is a schematic diagram of a vehicle door showing a partially closed window and an arrangement of transmitting and

receiving transducers which establish the monitoring beam for a nonlinear, rectilinear window edge according to this invention;

Fig. 3 is a schematic view of a vehicle sun roof partially closed showing the arrangement of transducers relative to a nonlinear, curvilinear edge according to this invention;

Fig. 4 is a schematic three-dimensional view of a single sensor corner receiver according to this invention;

Fig. 5 is a schematic three-dimensional view of a dual sensor corner receiver according to this invention;

Fig. 6 is a schematic top plan view of a transducer using a spring-biased interrupter according to this invention;

Fig. 7 is a side elevational view of a transducer accompanied by a camming surface for guiding obstructions into the beam;

Fig. 8 is a schematic view showing ambient light from the sun interfering with reception at the receiver;

Fig. 9 is a view similar to Fig. 8 wherein the reflected radiation from the transmitter is interfering with the operation of the receiver;

Fig. 10 is a schematic view of a transmitter and receiver employing shades according to this invention;

Fig. 11 is a view similar to Fig. 10 in which the transmitter and receiver are using both shades and filters according to this invention;

Fig. 12 is a schematic of a dual channel obstruction detection system for a vehicle window according to this invention using different frequencies for each channel;

Fig. 13 is a view similar to Fig. 12 wherein the channels may use the same frequency but are operated one at a time;

Fig. 14 shows the transmitter and receiver waveforms for each of the channels in Fig. 13; and

Fig. 15 is a schematic block diagram of a control circuit for operating the dual channel system of Fig. 13.

There is shown in Fig. 1 an obstruction detection system 10 for a vehicle window which uses a pair of transducers, transmitter 12 and receiver 14. Transmitter 12 includes an

emitter 16 which emits a narrow beam 18 of energy which may be sound, ultrasonic, infrared, or light, for example. This beam is received by sensor 20 in receiver 14. Transmitter generator circuit 22 energizes transmitter 12 to emit beam 18. To enhance noise rejection a modulation circuit 24 may be provided to modulate beam 18. The output from transmitter generator circuit 22 is also supplied to amplifier and bandpass filter circuit 26 so that any necessary modulation detection may be accomplished. If an obstacle 28 should interfere and obstruct beam 18, this is detected by sensor 20 in receiver 14, amplified in amplifier 30 and submitted to control 32, which then interrupts the power to window drive 34.

In order to efficiently provide a beam to monitor the nonlinear edge 40 of window 30 in door 36, Fig. 2, having a rectilinear form of two straight edges 42 and 44 joined at apex 46, three transducers 48, 50 and 52 are used. Transducers 48, 50 and 52 are mounted on section 55 of frame 54 which receives the edge 40 of window 38. Transducer 50 is the opposite type of transducer as that of transducers 48 and 52. Thus if transducer 50 is a transmitter, transducers 48 and 52 are receivers. Conversely, if transmitter 50 proximate the intermediate portion 46 is a receiver, then transducers 48 and 52 at the terminal portions 56 and 58 of edge 40 are transmitters. In this way, a beam which conforms closely to the contour of window edge 40 can be effected with a minimum number of transducers. Typical transmitters and receivers for use with infrared are COX14GE infrared emitter, L14C2GE infrared photo transistor; ultrasonic are P9923 ceramic ultrasonic transducer, P9934 ultrasonic ceramic microphone; sound are P9922 audio transducer, P9956 electrect condenser microphone; laser are P451 laser diodes, BPW38GE photo transistor; and light are P374 light emitter, PN116PA photo transistor.

A similar construction is shown with respect to sun roof 57, Fig. 3, where the sun roof panel 38a has terminal portions 56a and 58a and intermediate portion 46a.

In situations where transducer 50 is a receiver, there is a

need to prevent a blind spot from occurring whereby a finger or other small object might be crushed between the apex or intermediate portion 46 of window 38, Fig. 2, and the mating corner 47 of section 55, where transducer 50 is located. In that case a receiver 50', Fig. 4, having a single sensor 60 which is generally wide-angle, may be used so that even the smallest finger or similar object necessarily interferes with the beam 18', 18" even at its convergence at sensor 60. Such a receiver is a PN127-SPA NPN photo transistor.

Alternatively, a receiver 50", Fig. 5, may use two sensors 60', 60", which are made small enough, approximately 1/4 inch or less, so that each receives a portion of the beam 18', 18", but the space 62 between sensors 60' and 60" is made small enough so that even the smallest object to be detected would overlap and block one or the other of sensors 60' and 60" and provide the necessary interruption of beam 18', 18" to cause the control 32 to stop the window drive 34. Such a device is AEM (Automobile Environment Management) System from Prospects Corporation.

Whether transducer 50, Fig. 2, is a transmitter or a receiver, it may be constructed as shown in Fig. 6, where transducer 50'" has two sensors 62, 64 which may as well be emitters, and an interrupter or cover 66 which is biased by spring 68 away from sensors or emitters 62, 64 in the normal condition. However, when for example an advancing window edge pushes a finger against interrupter 66, interrupter 66 will be moved against the force of spring 68 until it covers sensors 62 and 64, thus interrupting beams 18' and 18", causing an indication of the presence of an obstacle and causing control 32 to stop window drive 34. Such a device is a AEM System from Prospects Corporation.

In any corner situation where an obstruction might be so small that it would miss blocking the transmitter or receiver, the transmitter or receiver 70, Fig. 7, may be mounted in conjunction with a camming surface 72 which would guide a finger 74 towards the transistor or receiver, driven by advancing window edge 76 until finger 74 is compelled to block beam 18. Receiver

70 may be approximately 1/4 inch or less in diameter and surface 72 may have a radius which varies from 3 inches to 30 inches.

Often when a beam 80, Fig. 8, is being transmitted from transmitter 82 to receiver 84, the presence of an obstacle 86 may not be detected because of ambient noise. For example, if beam 80 is a light beam then the ambient light from sun 88 may be such as to overdrive or saturate receiver 84 so that even if beam 80 is totally blocked by obstacle 86, receiver 84 receives sufficient light so that it provides no indication that an obstruction has occurred. The same type of interference can occur when the beam from transmitter 82 itself is deflected as beam 80' Fig. 9, from a surrounding surface 90, so that receiver 84 does not detect the presence of obstacle 86.

This may be remedied in a number of ways according to this invention. As shown in Fig. 10, receiver 84 may be provided with a shade 92 that blocks not only the rays of sun 88, but also the deflected beam 80'. A similar shade 94 may be used on a housing mounted with transmitter 82. Alternatively, band pass filter 96, Fig. 11, may be used to screen from receiver 84 all but the particular frequency of light, sound or other energy beam, except that originally contained in beam 80. This of course would not prevent the effect of the deflected beam 80' because it would have the same frequency as beam 80 since it is derived from that beam. However, with further improvement of transmitter or receiver construction such an effect can be eliminated. Shade 92 as well as shade 94 may be employed along with filter 96.

In another approach, a dual-channel system 100, Fig. 12, may be used wherein channel A includes transmitter 82a which transmits beam 80a toward receiver 84a. Channel B is reversed with respect to channel A so that transmitter 82b is proximate receiver 84a and receiver 84b is proximate transmitter 82a. This is done so that if the ambient energy is incident upon receiver 84a, it is unlikely that it could also be incident upon receiver 84b, since 84b is in the opposite direction from receiver 84a. When an obstacle 86 is present, it is possible that beam 80a could strike obstacle 86 as indicated at 80aa and be reflected as

also indicated along 80aa so that it would strike receiver 84b. The same thing would happen with respect to beam 80b whereby beam 80bb would be reflected to receiver 84a. To prevent this crossover between the channels, beam 80a and beam 80b are selected to have two different frequencies such as 20 KHz/70 KHz. The receivers are therefore tuned to different frequencies and either one can interfere with the other.

Alternatively, as shown in Fig. 13, a dual channel system may be constructed in which channel A and channel B provide energy beams 80c and 80d of the same frequency, but their operation is sequenced or muiltiplexed so that only one beam is on at a time. Thus transmitter 82c sends out a series of pulses 82cc, Fig. 14, which are received by receiver 84c by the series of pulses 84cc. Any difference between the received pulses 84cc and the transmitted pulses 82cc is an indication that an obstacle has been detected. The period between the pulses, shown crosshatched at 83cc, are ignored, because during this period transmitter 82d is generating pulses 82dd and receiver 84d is receiving a like series of pulses 84dd. The crosshatched areas indicated at 85dd are the periods during which the input to receiver 84d is ignored, since they are occurring during the period of the pulses 82cc, 84cc. The timing diagram, Fig. 14, also shows the fail safe detection diagnostic operations. The active time period before time line 102 indicates the active fail safe detection time interval. Before the vent closing operation, a diagnostic OFF/ON signal is sent out from the transmitter. The receiver should correspondingly receive the same signal pattern as monitored by the processor 120. Otherwise, a warning message is generated by processor 120 and the automatic close-vent operation is blocked. This can be accomplished using a main controller such as microprocessor 120, Fig. 15, which drives switch control 122, operates switch 124 to connect the transmitter generator 22, Fig. 1, to switch 124, and selects which of transmitters 82c and 82d is turned on in the alternating sequence. A second switch 126 may be employed, also supervised by switch control 122, so that the receiver circuits 26, 30, 32

will not even see the signal from the other channel. Switch 126 may also be used under control of microprocessor 120, so that if an obstruction is indicated in one of the channels and not the other, indicating that the one channel is giving false readings, switch 126 can be simply connected continuously to the still credible channel so that only outputs from that channel are processed for determination of whether a true obstruction has occurred.

Although specific features of the invention are shown in some drawings and not others, this is for convenience only as each feature may be combined with any or all of the other features in accordance with the invention.

Other embodiments will occur to those skilled in the art and are within the following claims:

What is claimed is:

CLAIMS

1. A dual channel obstruction detection system for monitoring the closure of the edge of a vehicle window with its frame, comprising:

a first channel including a first transmitter and a spaced first receiver mounted with said frame proximate the section of said frame which receives the edge of said window for establishing a first energy beam propagating along said section of said frame;

a second channel including a second transmitter and a spaced second receiver mounted with said frame proximate the section of said frame which receives the edge of said window for establishing a second energy beam propagating along said section of said frame; said beams propagating in opposite directions with said first transmitter and second receiver being at one end of said beams and said second transmitter and first receiver being at the other for enabling each said receiver to present an opposite field of view to incident ambient noise energy.

2. The dual channel obstruction detection system of claim 1 in which the beam of said first channel and the beam of said second channel are of different frequencies to prevent channel crossover of the beams.

3. The dual channel obstruction detection system of claim 1 further including means for monitoring only one beam at a time for preventing channel crossover of said beams.

4. The dual channel obstruction detection system of claim 1 further including shade means extending from each receiver along said beam direction towards the associated transmitter for preventing ambient noise energy from striking said receiver and masking the condition of the associated beam.

5. The dual channel obstruction detection system of claim 1 further including filter means at each receiver for preventing

ambient noise energy from striking said receiver and masking the condition of the associated beam.

6. The dual channel obstruction detection system of claim 1 in which said energy beam is an infrared beam.

7. The dual channel obstruction detection system of claim 1 in which said energy beam is a sound beam.

8. The dual channel obstruction detection system of claim 1 in which said energy beam is an ultrasound beam.

9. The dual channel obstruction detection system of claim 1 in which said energy beam is a laser beam.

10. The dual channel obstruction detection system of claim 1 further including means for determining whether said transmitters and receivers are operating.

11. An obstruction detection system for monitoring the closure of a vehicle window with its frame in which the window has a nonlinear edge to be monitored, the edge including two terminal portions and an intermediate portion, comprising:

three spaced transducers disposed on the section of the frame of the window which receives said edge, one proximate each said edge portion of the associated window for propagating a narrow energy beam between each of the terminal portions and the intermediate portion, the transducer at aid intermediate portion being one of a transmitter and a receiver an the transducer at said terminal portions being the other for closely conforming the track of the beams to the nonlinear contour of the window edge; and

means, responsive to each said receiver, for indicating a blockage in the path of said window in response to an interruption of said beam.

12. The obstruction detection system of claim 11 in which said edge is rectilinear.

13. The obstruction detection system of claim 11 in which said edge is curvilinear.

14. The obstruction detection system of claim 11 in which said edge transducer at said intermediate portion is a transmitter and the transducer at each said terminal portion is a receiver.

15. The obstruction detection system of claim 11 in which said edge transducer at said intermediate portion is a receiver and the transducer at each said terminal portion is a transmitter.

16. The obstruction detection system of claim 15 in which said receiver has a single sensor for receiving the beams from both transmitters.

17. The obstruction detection system of claim 15 in which said sensor is a wide angle sensor.

18. The obstruction detection system of claim 16 in which said sensor is no larger than the smallest object to be detected obstructing the closure of said window.

19. The obstruction detection system of claim 16 in which said receiver includes two sensors, one for receiving the beam from each transmitter, and the separation between said sensors is smaller than the smallest object to be detected obstructing the closure of said window.

20. The obstruction detection system of claim 15 in which said receiver includes two sensors, one for receiving the beam from each transmitter, and said receiver includes an interrupter

normally biased clear of said sensors but movable by an obstruction driven by closure of said window to overcome the bias and dispose said interrupter to block at least one of said beams.

21. The obstruction detection system of claim 14 in which said transmitter includes two emitters, one for transmitting the beam to each receiver, and said transmitter includes an interrupter normally biased clear of said emitters but movable by an obstruction driven by closure of said window to overcome the bias and dispose said interrupter to block out least one of said beams.

22. The obstruction detection system of claim 11 in which said beams are infrared.

23. The obstruction detection system of claim 11 in which said beams are ultrasound.

24. The obstruction detection system of claim 11 in which said beams are sound.

25. The obstruction detection system of claim 11 in which said beams are light.

26. The obstruction detection system of claim 11 further including a secondary transmitter and receiver mounted with said frame for establishing a secondary beam remote from said section of said frame for monitoring progress of said edge of said window before closure of said window edge with said frame section.

27. The obstruction detection system of claim 11 further including means for determining whether said transmitters and receivers are operating.

28. An obstruction detection system for monitoring the closure of the edge of a vehicle window with its frame,

comprising:

a transmitter, mounted on the section of the frame which receives the window edge, for transmitting and a receiver, mounted on the section of the frame which receives the window edge and spaced from said transmitter, for receiving a narrow energy beam adjacent said section of said frame;

means, responsive to said receiver, for indicating a blockage in the path of said window in response to an interruption of said beam; and

shade means extending from said receiver along said beam direction towards said transmitter for preventing ambient noise energy from striking said receiver and masking the condition of said beam.

29. The obstruction detection system of claim 28 further including filter means at said receiver for preventing ambient noise energy from striking said receiver and masking the condition of said beam.

30. The obstruction detection system of claim 28 further including means for determining whether said transmitter and receiver are operating.

31. An obstruction detection system for monitoring the closure of on the edge of a vehicle window with its frame, comprising:

a transmitter, mounted on the section of the frame which receives the window edge, for transmitting and a receiver, mounted on the section of the frame which receives the window edge and spaced from said transmitter, for receiving a narrow energy beam adjacent said section of said frame;

means, responsive to said receiver, for indicating a blockage in the path of said window in response to an interruption of said beam; and

filter means at said receiver for preventing ambient noise energy from striking said receiver and masking the

condition of said beam.

32. The obstruction detection system of claim 31 further including shade means extending from said receiver along said beam direction towards said transmitter for preventing ambient noise energy from striking said receiver and masking the condition of said beam.

33. The obstruction detection system of claim 31 further including means for determining whether said transmitter and receiver are operating.

34. An obstruction detection system for monitoring the closure of on the edge of a vehicle window with its frame, comprising:

a transmitter mounted on the section of the frame which receives the window edge for transmitting and a receiver mounted on the section of the frame which receives the window edge and spaced from said transmitter for receiving a narrow energy beam adjacent said section of said frame; at least one of said transmitter and receiver being mounted proximate a corner of said frame section;

a cam surface for receiving an obstructing object driven by said closing window and guiding it to block said beam; and

means responsive to said receiver for including a indicating a blockage in the path of said window in response to an interruption of said beam.

35. The obstruction detection system of claim 34 further including means for determining whether said transmitter and receiver are operating.

36. An obstruction detection system for monitoring the closure of on the edge of a vehicle window with its frame, comprising:

a transmitter, mounted on the section of the frame which receives the window edge, for transmitting and a receiver, mounted on the section of the frame which receives the window edge and spaced from said transmitter, for receiving a narrow energy beam adjacent said section of said frame;

means, responsive to said receiver, for including a indicating a blockage in the path of said window in response to an interruption of said beam; and

a secondary transmitter and receiver mounted with said frame for establishing a secondary beam remote from said section of said frame for monitoring progress of said edge of said window before closure of said window edge with said frame section.

37. The obstruction detection system of claim 28 further including means for determining whether said transmitter and receiver are operating.

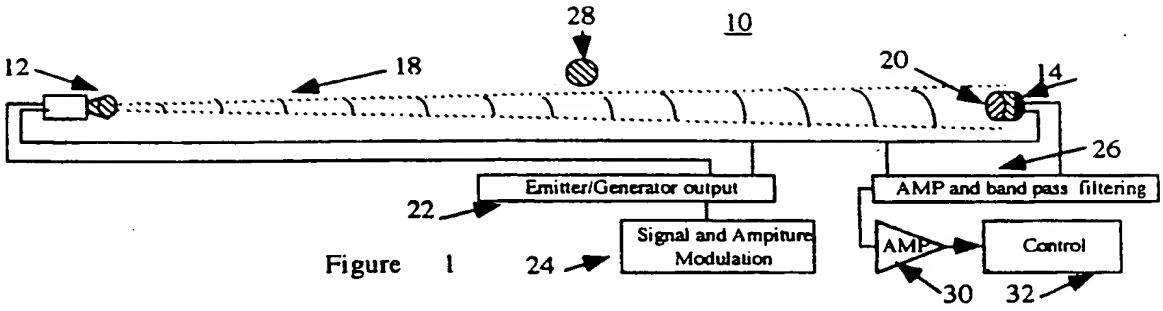


Figure 1

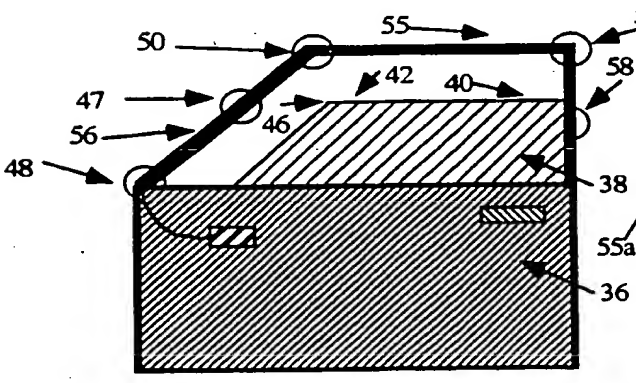


Figure 2

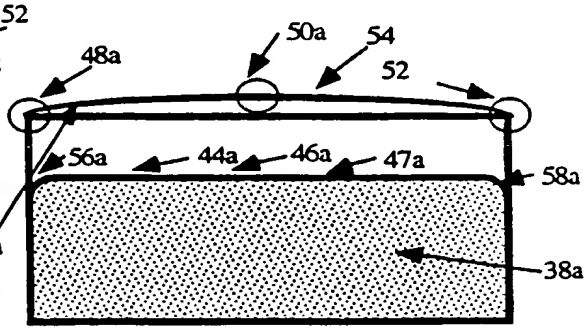


Figure 3

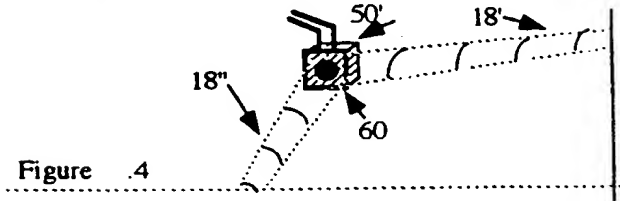


Figure 4

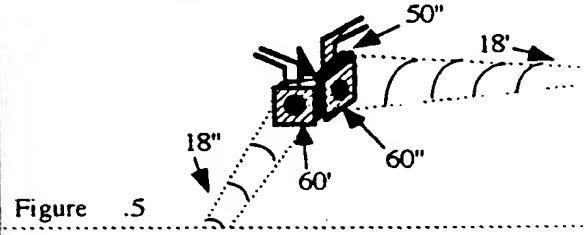


Figure 5

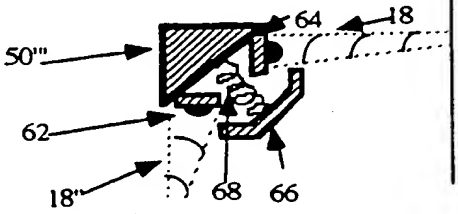


Figure 6

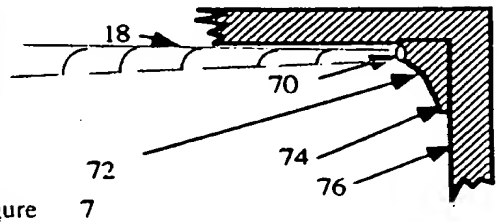


Figure 7

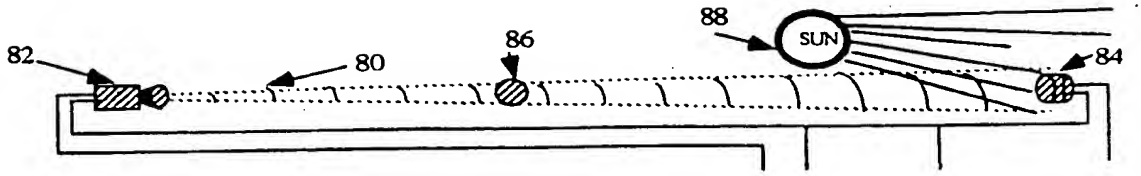


Figure 8

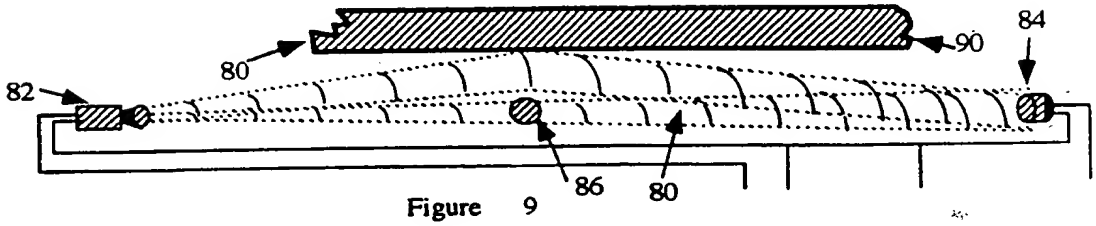


Figure 9

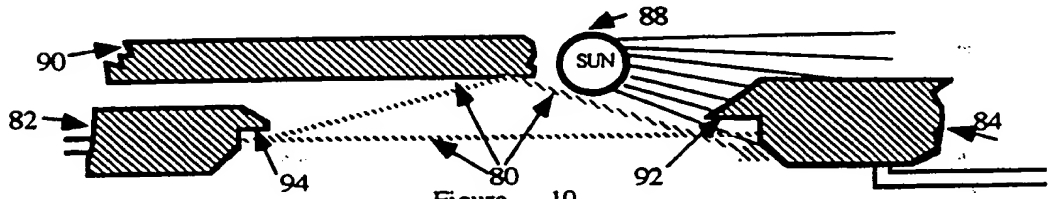


Figure 10

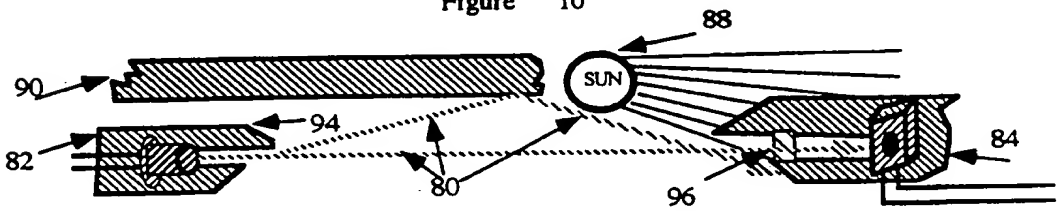


Figure 11

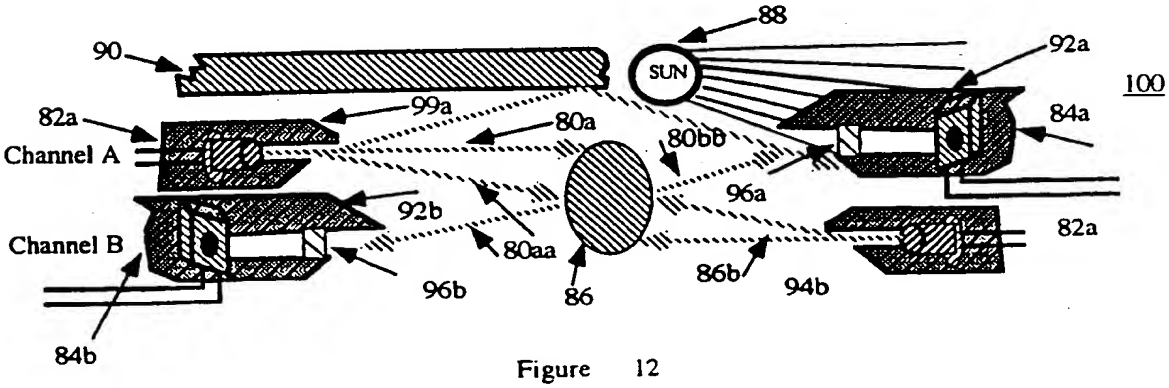


Figure 12

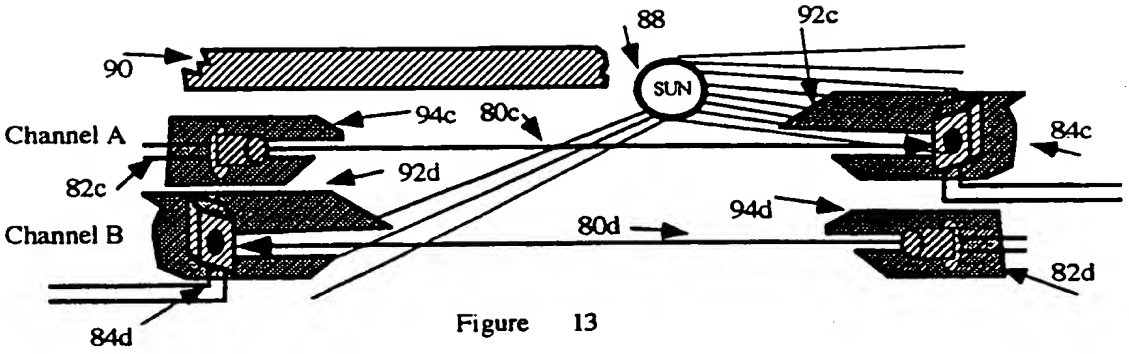


Figure 13

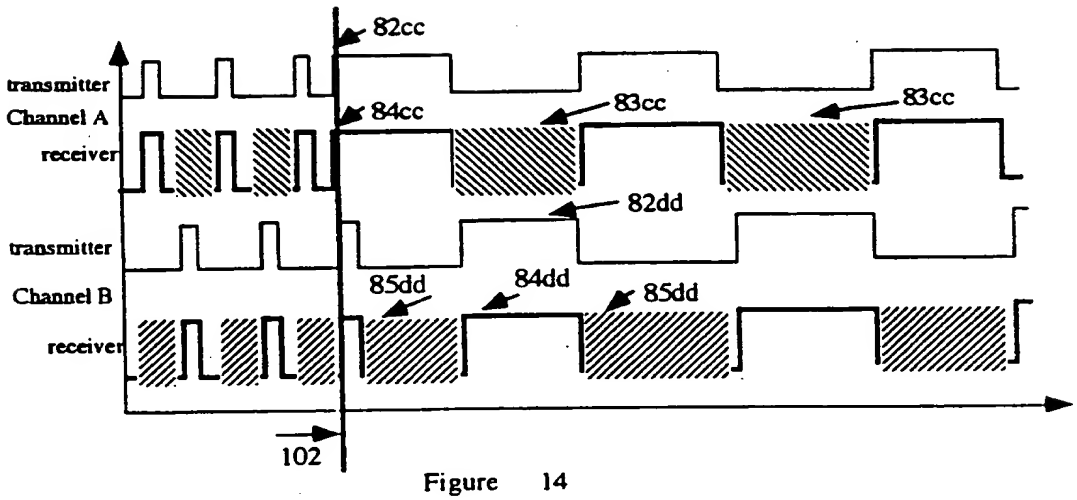


Figure 14

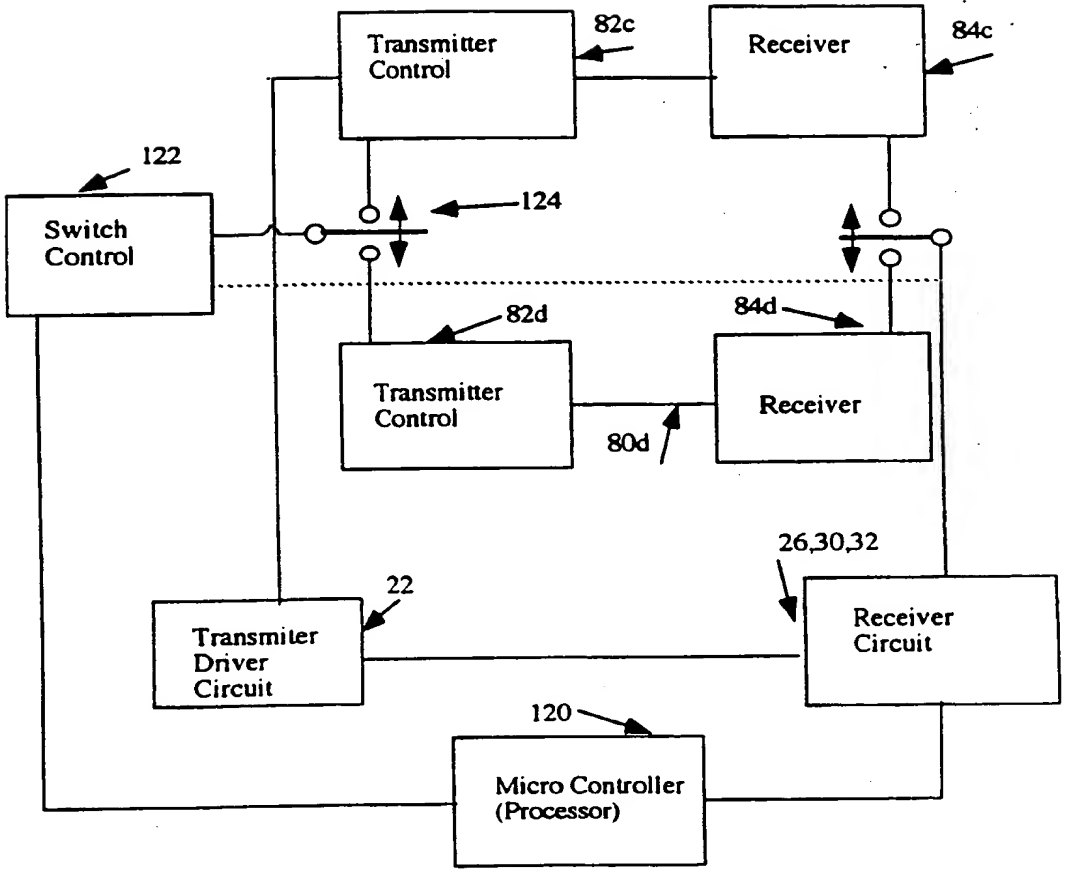

Transmitter Control
82c
Receiver
84c
122
Switch Control
124
82d
84d
Transmitter Control
Receiver
80d
26,30,32
22
Transmiter Driver Circuit
Receiver Circuit
120
Micro Controller (Processor)

Figure 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/09257

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :E05F 15/02
US CL :49/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 49/26, 28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	A, 4,773,183 (Okushima et al) 27 September 1988, see entire document.	28-37
A	A, 3,710,050 (Richards) 09 January 1973, see entire document.	1-37
A	A, 3,662,491 (Boyriven) 16 May 1972, see entire document.	1-37

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 12 JANUARY 1994	Date of mailing of the international search report 27 JAN 1994
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE	Authorized officer JERRY REDMAN Telephone No. (703) 308-2168

Form PCT/ISA/210 (second sheet)(July 1992)*